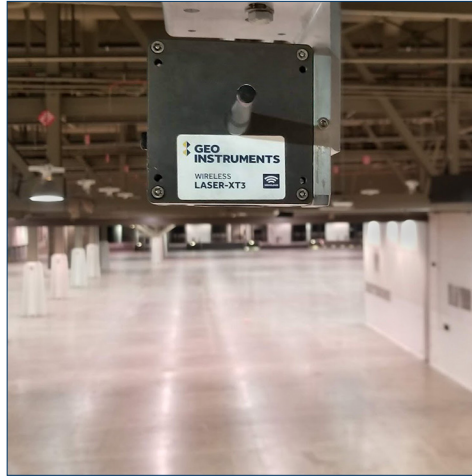




Laser-Tilt sensors monitored deflection of arches as they took on the load of the bridge deck.



Laser-Tilt sensors monitored potential deflection of the floor slab as a TBM passed beneath the building.



Laser-Tilt sensors monitored the stability of bridge piers while repairs were made to the bumper system.

Laser-Tilt Sensor Applications

- Monitoring the stability of structural elements during adjacent repairs or excavations.
- Monitoring deformation of tunnels and culverts during adjacent construction.
- Monitoring deflection of structural elements during transfer of loads.
- Monitoring deflection of floor slabs during passage of TBM.
- Monitoring rotation from horizontal in two axes and other tiltmeter functions.

Laser-Tilt Sensor Components

Laser-tilt sensor components include a laser distance sensor, a tiltmeter, and a self-powered, wireless controller, all housed in a compact enclosure.

The laser sensor measures the distance between itself and a non-reflective natural-surface target. Changes in the measured distance indicate that displacement has occurred.

The tilt sensor measures inclination relative to gravity and reports rotation from the horizontal plane. Tilt measurements can also confirm that sensor mounting point is stable.

The wireless controller is a “node” that transmits readings from both sensors to an internet gateway. Some controllers offer full datalogging capabilities, as well.



FlatMesh Laser-Tilt Sensor

Laser: Class 2, 655nm, visible red.
 Range: 165 feet to natural surface target.
 Resolution: 0.004 inch.
 Repeatability: ± 0.006 inch.
 Tilt Sensor: MEMS x three axes.
 Range: $\pm 90^\circ$ in each axis.
 Resolution: 0.0001°.
 Repeatability: $\pm 0.0005^\circ$.
 Battery life: 8 years at 30 minute intervals. 10 years at 1 hour intervals.
 Environmental: IP68 at 1m for 24 hours, -10°C to $+50^\circ\text{C}$.
 Controller: FlatMesh Node with Read & Send functions. Uses 2.4 Ghz radio and Senceive FlatMesh protocol to send measurements to a FlatMesh internet gateway.



LoRaWan Laser-Tilt Sensor

Laser: Class 2, 655nm, visible red
 Range: 492 feet to natural surface target.
 Resolution: 0.004 inch.
 Repeatability: ± 0.006 inch
 Tilt Sensor: MEMS x three axes.
 Range: $\pm 90^\circ$ in each axis.
 Resolution: 0.0001°.
 Repeatability: $\pm 0.0003^\circ$.
 Battery life: 3 years at 5 minute intervals. 10 years at 1 hour intervals.
 Environmental: IP 68 at 2m, 2 hours, -40°C to $+85^\circ\text{C}$.
 Controller: LoRaWan datalogger with Read, Record, & Send functions. Stores 100k readings of both sensors. Uses 900Mhz radios and World Sensing protocol to send measurements to a LoRaWan internet gateway.